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## Development of earth occupation standards within the UK

While Europe has a rich heritage of earth construction and growing number of contemporary buildings, it remains minimal. Earthen construction is increasingly being academically investigated (Pacheco-Torgal & Jalali, 2012), as a means of achieving low environmental impact construction materials (Maskell et al., 2015). While the focus of the research is either on improvement of mechanical properties (Walker et al., 1995, Morel et al., 2007) or moisture buffering properties (McGregor et al., 2015). Increasing academic research helps to address one of the 12 barriers of adoption identified by Sourani and Sohail (2011), however this alone will have minimal impact on the adoption of the earth construction.

Sourani and Sohail (2011) include within their twelve barriers to adoption of sustainable forms of construction that could be addressed by standards and certification:

- insufficient/inconsistent policies, regulations, incentives and commitment by leadership;
- insufficient/confusing guidance, tools, demonstrations and best practice;
- vagueness of definitions and diversity of interpretations;

To address these challenges professionals of the construction sector, 18 partners from 8 European countries were part of the PIRATE project to establish a complete European Credit System for Vocational Education and Training (ECVET) for earth building. ECVET is the European approach to develop vocational education and training fostered through mobility of both learners and professionals. ECVET sets a framework for different national educational systems, allowing learners to validate in their own countries the training and certification received abroad. Callender, (1992) demonstrated the effectiveness of national vocational qualifications in construction, particu-

larly the need to train the trainers to maintain high training standards and credibility.

This paper presents the outcomes of the PIRATE project. The European outcomes of the project will be discussed with how they have been used to translate to UK's vocational accreditation system. This will have significant impact across Europe with respect to enabling earth construction to be internationally recognised and certified.

### European Earth Building Context

The wider picture of construction in Europe has been wide-scale use of high energy building materials which fit into the general classification of products. The commercial success of products over skills has been a feature of construction which makes it both extremely profitable as a sector and highly vulnerable to wider economic shocks (Duca et al., 2010 and Nistorescu et al., 2010). Products have led to the growth of standards and certification. Within Europe, standards for earth construction are limited to Germany via the DIN Standards (DIN 18945, 18946 and 18947) which were developed by German National association for earth construction, the Dachverband Lehm e.V.

Earth building in the UK has as long a history (Morton, 2007) as most other areas of the world (Houben & Guillaud, 1994). The use of earth as a building material was largely vernacular, with whole towns in the UK constructed of locally sourced clay with regional variations of cob, clay mortared clay and stone blocks, wattle and daub and rammed earth. This practice continued until the industrial revolution from the 18th to the 20th century. Industrialisation and mass transport had a massive impact on earth building with a dwindling number of people with the skills to use it. This was in stark contrast to the idea

Unit	Subunit	EQF Level	L1	L2	L3	L4	L5	Description
M								From raw material to earth mix
P								Production of prefabricated elements
B	B1 earth masonry							
	B2 cob							Building with earth
	B3 rammed earth							
C								Application of clay plaster
F								Formwork for earth building
R	R1 building							
	R2 clay plaster							Repair and conservation in earth building
D								Interior design
O								Decorative techniques
E								Earth building market

Table 1 Earth Building ECVET matrix

of 'modern' construction materials and a 'modern' architecture. However the existence of thousands of earth buildings ensured it remained current for a range of different people. These included those living and maintaining the buildings, local authorities, NGO's and government concerned with the protection of UK heritage. While new build in the UK and Ireland has largely been with cob and earthen plasters other skills in wattle and daub and clay mortared masonry are also gaining use and interest. Rammed earth has attracted interest in highly contemporary designs such as the CAT centre at Wise as in Fig. 1. Maskell et al., (2015) has demonstrated the potential for earth to be used as a structural material potentially meeting certification requirements whilst delivering significant environmental benefits. However there remains no standard approach to specifying or designing with this material that has its historical routes as a craft.

The modern approach to products and standard impacts the socio-economic landscape (Turk 2009 and Nistorescu & Ploscaru, 2010) including the dilution of skills-based construction sector. Prior to the ECVET PIRATE project training standards for earth plasters was initially developed across Europe (D/02/B/F/PP-112 695) which expanded to further projects considering plasters (2012-1-FI1-LEO05-09362) and other natural building materials (CZ/08/LLP-LdV/TOI/134015). Recognizing that Earth plasters are a subset of Earth construction, the PIRATE project (528117-LLP-1-2012-1-FR-LEONARDO-LMP) was developed.

### Development of the earth building ECVET

The project allows for standardised certification that is recognised across Europe, for the vocational training in earth building. Consortium partners from eight European countries met regularly to learn about and compare typical building technologies, norms and standards, and trades and crafts of different countries. The results were the development of a matrix of units of learning outcomes for construction, renovation and decoration with earth materials.

The EQF is a common European reference framework which links countries' qualifications systems together, acting as a translation device to make qualifications applicable across different countries and systems in Europe. The EQF framework (EQF, 2008) uses eight levels of competency ranging from basic Level 1 to advanced Level 8. Within construction levels 3 and 4 apply to workers taking responsibility for completion of tasks and exercising self-management respectively. Levels 5 and 6 apply to supervisors managing technical activities, responsible for decision-making in unpredictable contexts. Level 7 is suitable for the design team including architects and engineers with level 8 reserved for academics.

The Earth building ECVET consists of a matrix of nine units for EQF levels 3 to 6 (Table 1). The units consider a range learning outcomes required for earth building, including practical elements, such as material preparation and construction through to developing a business for constructing with Earth. In

recognition of the variety of earth construction, three units have been developed for the specifics of earth masonry, cob and rammed earth. Each unit considers a set of knowledge, skills and competence needed to be demonstrated appropriate for the level. These are assessed against a list of criteria and indicators via written, practical and oral exams. The framework allows for many different implementations of training, practice and assessments facilitating lifelong learning and flexibility for national implementation.

### UK's implementation of ECVET

Earth Building UK and Ireland (EBUKI) (Maskell and Keable, 2016) approached the UK Construction Industry Training Board (CITB) proposing a change to the UK National Occupational Standard (NOS). The UK has a National Vocational Qualification (NVQ) used to assess competency within a particular subject. The NVQs are broken down into eight levels and while they have academic equivalence, the focus is distinctly vocational. To achieve this training at any level there has first to be a National Occupational Standard (NOS), which specifies the UK standards of performance including the knowledge and skills required. The NOS are approved by the four UK home nations, England, Scotland, Wales and Northern Ireland. NOS exist for a wide variety of construction skills including Heritage Skills. Within Heritage Skills there was an existing NOS which discussed earth building having and requiring skills. However, there was no additional detail to express what earth building is, to name even the techniques or materials associated with it.

With materials developed within Pirate, EBUKI was uniquely positioned as experts on the Construction Industry Training Board, CITB Technical Committee (TC), as a professional organisation to 'the industry' and achieving a nationally recognised training standard. Each European country governs their training standards differently. In the UK the CITB were set up by the 1964 Industrial Training Act by the Minister of Labour. This gave statutory powers to create industrial training boards responsible for training in a number of UK industries, setting standards and providing advice to firms. This was amended in 1982 to become funded by an industry levy. The change to being industry funded made the Board very responsive to industry requests.

Bringing the new detail to an existing training NOS was achieved by convening a TC of industry profes-

sionals including EBUKI and working through the existing document to update and fill in the detail of what became COSVR549 "Prepare and erect or conserve and restore earthen structures". A key part of this was to shift the emphasis from being purely for conservation and repair of earth buildings to begin with the phrase Prepare and Erect, meaning build new. Once the NOS was published in August 2015 the next phase of the development of the standard was triggered, namely in developing the National Vocational Qualification, NVQ.

The UK training and assessment model allows for training and assessment either in training centres or on site, but the emphasis is on-site. To achieve this qualification, regardless of level there has first to be a National Occupational Standard, NOS.

### Conclusions

The outcomes of the PIRATE project has provided the detailed working material for a training standard to be taken up and used across Europe in a common qualifications framework. The European vision of Lifelong Learning needs these kinds of outputs to clothe that vision, allowing trained people to move from one country to another taking skills with them or learning new skills to take back to their home nations. This is a vision shared and endorsed by EBUKI and actively promoted in the writing and dissemination of the work of Pirate into the UK national regulatory system. The directly certified construction training framework in the UK opens the door to earth structures and training by industry with the newly published NVQ's. The next step which we hope will continue in the European model will be to implement training programs to take advantage of these changes.

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